

in very short periods of time. The spots of light of the horizontal force and vertical force magnets passed beyond the range of the recording barrels for many hours during the afternoon and evening, and for shorter periods at other parts of the day, but little loss will be incurred on this account, as eye observations were made in great detail. Active disturbance ceased about November 1^d 5^h, the movements gradually subsiding after midnight. The declination magnet reached its extreme westerly position at October 31^d 15^h 40^m and its most easterly position at 31^d 19^h, the extent of change exceeding 2°.

This disturbance is greater than any recorded at the Royal Observatory since the great disturbance of 1882 November 17, which it closely resembled in many respects.

Royal Observatory, Greenwich :
1903 November 12.

Observations of Mars in 1903. By the Rev. T. E. R. Phillips, M.A.

The planet *Mars* was in opposition on 1903 March 28. His maximum diameter scarcely reached 14''·6, but the apparition was nevertheless a very favourable one for an examination of the planet's N. hemisphere. The latitude of the centre of the disc was +22°·6 at the time of opposition, and increased to over 25° by the middle of May. The weather, too, was on the whole very propitious, and the seeing conditions, despite some bad periods, frequently excellent. Between the middle of February and the end of May I was able to observe the planet on no fewer than sixty-six occasions. Thirty-two whole-disc drawings were made, besides drawings of special features. The instrument employed was a 9¼-inch silvered-glass reflector (mirror by With), with powers between 217 and 450.

The following is a description of the results obtained, the letters and numbers referring to the accompanying chart:—

The Maria.—The boundaries of the *Maria* were very well defined, and, in some cases, bordered by bright regions. As usual the *Maria* were by no means uniform in depth of tone, lighter and darker patches being frequently seen. The *Syrtis Major* (H) especially contained brighter areas—*Ænotria* (α'), *Iapygia* (β)—in its S. portion, but was very dark towards its N. extremity. The *Syrtis Minor* (G), *Sinus Sabæus* (I), *Margaritifer Sinus* (A), *Auroræ Sinus* (D), *Mare Acidaliæ* (B), and *Baltia* (C) were all noted as dark. *Mare Sirenum* (E), doubtless in consequence of its proximity to the limb, appeared less dark than usual. *Atlantis* separating it from *Mare Cimmerium* (F) was not

observed, though *Hesperia* (ϕ) was clearly seen. The large dusky area in the neighbourhood of the *Casius* (44) was very prominent, and contained two large dark spots or condensations.

The "Canals."—Several canals were seen with great distinctness. I have no doubt whatever as to the actual existence of many of them, though it is quite probable that at closer quarters they would appear much less regular. The theory that their appearance results from the unconscious joining together by the eye of projections from the *Maria* and dark spots does not satisfy the observations. The soft delicate lines or narrow streaks were frequently seen with great distinctness when no such prominent features were visible to account for them.

The interesting experiments described by Mr. E. W. Maunder and Mr. J. E. Evans in their paper published in *Monthly Notices* for 1903 June seem to me on careful consideration to suggest only a partial explanation of the canal system. They illustrate well what is very probably true—viz. that many of the reported canals are not really straight lines, but the impression produced on the retina by irregular markings, too faint and intricate to be clearly grasped. On the other hand there are canals so distinct and plain, under conditions of the very finest definition, as to preclude the idea that they are in any way subjective or imaginary.

A careful and systematic scrutiny of the planet reveals the noteworthy fact that the so-called "canal system" includes features of widely different nature and appearance. Dark and broadish bands, soft and delicate streaks with ill-defined condensations and spots, fine narrow dark lines, and the dusky edges of faint shadings and half-tones, are all termed "canals." It seems to me, therefore, that one hypothesis will neither explain them all, nor establish the contention that the canals generally are illusory.

The following is a list and description of the canals seen :

Agathodaemon (11). Dark and obvious.

Alcyonius (41). Not a separate canal, only the edge of dark shading of *Utopia*.

Amenthes (43). Distinct dusky line or narrow streak.

Astaboras (51). Glimpsed sometimes, but difficult.

Astusapes (50). Rather difficult.

Boreas (29). Rather dark. Very well seen on several occasions.

Boreosyrtris (49). Very dark and conspicuous. The region between this and the *Nilosyrtris* is lightly shaded.

Callirhoe (5). Very well seen as a soft streaky line.

Casius (44). Very large dark shading. In no sense canaliciform.

Cephissus (42)*. Broad and dark.

* By an error both the *Cephissus* and the *Marsyas* are numbered (42) on

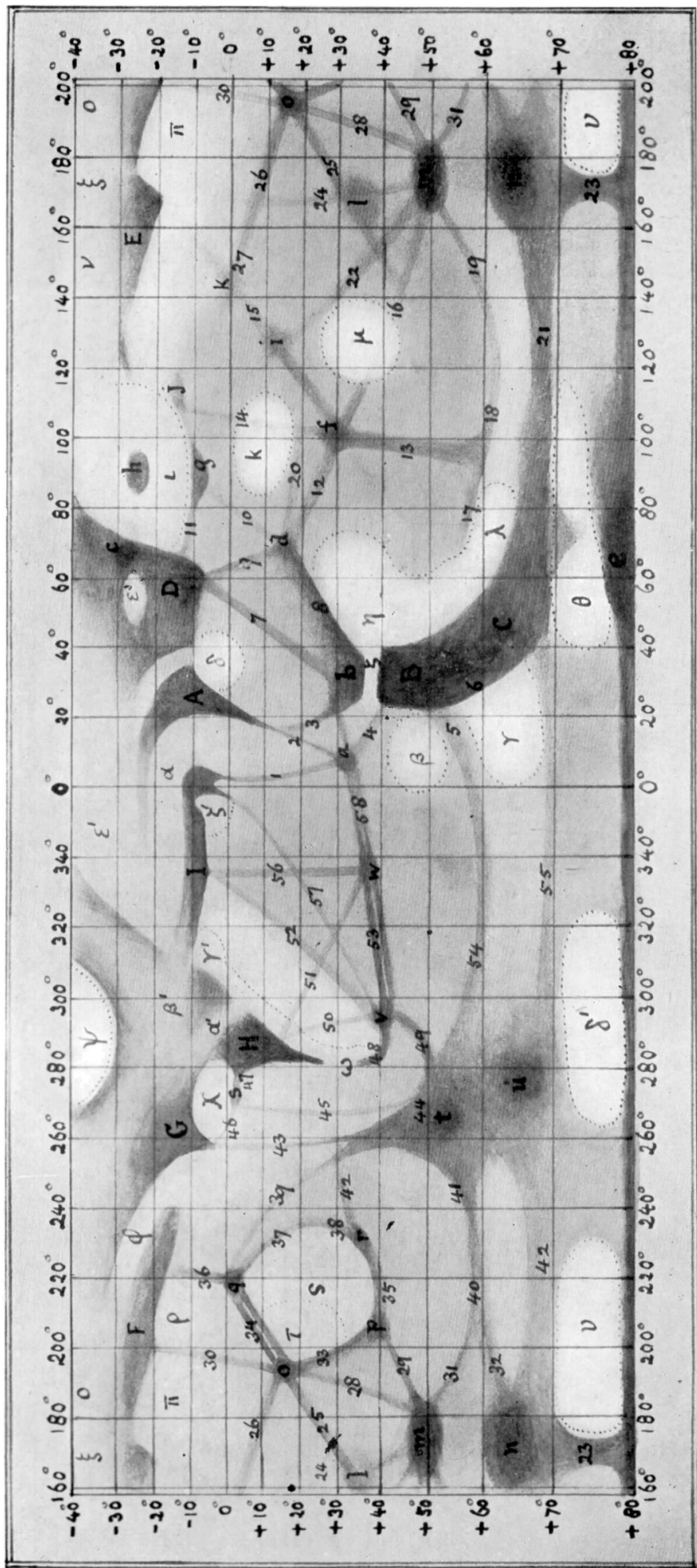


CHART OF MARKINGS ON MARS.

SEEN AT CROYDON ABOUT THE OPPOSITION OF 1903

REV T. E. R. PHILLIPS.

Ceraunius (13). Broad and rather diffuse.

Cerberus (34). Very dark and conspicuous. Straight and double, with shading between the two components. The doubling may possibly be an illusion, but it was distinctly apparent on several occasions with high powers and under the finest seeing conditions.

Chaos (35). Rather dark and sharply bounded to S.

Choaspes (32). Short broad streak connecting *Arsenius L.* with *Gyndes*.

Chrysorrhoea (10). Distinct and fairly easy.

Clavius (18). Fairly conspicuous, but soft.

Cyclops (36). Dark, rather broad, and very easy.

Deuteronilus (58). Rather dark and easy.

Erebus (25). Very readily seen on a good night. On April 22 it was noted as "dark, strong, and very obvious."

Eumenides (27). Faint and very difficult. Only a part seen.

Eunostos (37). Sharply bounded towards *Elysium*.

Euphrates (56). Beautifully soft, narrow streak. It seemed to terminate in *Ismenius L.* I was quite unable to trace its continuation in the *Arnon*.

Eurotas (19). Continuation of *Clavius*. Soft streaky line.

Ganges (9). Rather broad.

Gehon (1). Rather narrow, but soft.

Gigas (15). Very well seen as a soft and somewhat irregular streak, which at times gave the impression of consisting of hazy, ill-defined condensations and patches. The *Gigas* apparently starts from *Mareotis L.*, and not from the junction of *Ceraunius* (or *Iris*) and *Uranus*.

Granicus (31). Distinctly seen connecting the W. end of *Propontis* with the *Gyndes* and *Choaspes*.

Gyndes (40). Broad and dark streak.

Hades (28). Rather dark and conspicuous.

Hyblæus (38). Very much plainer than at recent oppositions. Dark and sharply bounded towards *Elysium*.

Indus (3). Distinct and fairly dark. The area included by *Indus*, *Oxus*, *Jordanis*, and E. end of *Achillis Pons* is shaded.

Iris (14). Well seen as a narrow continuation of *Ceraunius*.

Jamuna (7). Soft shading, but seen very distinctly on May 7.

Jaxartes (6). Not seen as a canal. The p. edge of *Mare Acidalium*.

Jordanis (4). Seen very distinctly connecting *Siloe Fons* with *Mare Acidalium*.

Læstrygon (30). Rather narrow, but not difficult.

Magnes (23). Dark and conspicuous feature connecting p. end of *Arsenius L.* with dark shading round polar cap, and forming E. boundary of elliptical white area.

Marsyas (42).* Frequently seen connecting *Morpheus L.* with the *Pactolus*.

the chart. The *Cephissus* is the broad band connecting *Arsenius L.* with the unnamed spot (*u*). The *Marsyas* extends W. from *Morpheus L.*

Nepenthes (47). Short and dark, swelling out into *Mæris L.*

Nilokeras (8). Quite dark and sharply bounded on N. edge. Soft and diffuse to S. In previous apparitions this canal has appeared "anomalously" double.

Nilosyrtis (48). Dark curved line, frequently seeming separated from the tip of *Syrtis Major*.

Nilus (12). Rather conspicuous, but soft and streaky.

Orcus (26). Faint and difficult.

Oxus (2). Narrow and sharp near *Margaritifer Sinus*, but becoming more diffuse towards *Siloe Fons*.

Pactolus (39). Seen frequently as a curved narrow streak connecting *Pambotis L.* with the *Casius*.

Pallas (46). Probably illusory. Only the edge of shading round *Libya*.

Phison (52). Appeared to be the dusky edge of orange tone of disc.

Phlegethon (16). Interrupted by white area central at about $\omega = 128^\circ$, $\phi = +35^\circ$.

Pierius (54). Dark and conspicuous streak.

Protonilus (53). Very dark and prominent. Appeared distinctly double on May 12 with Dr. Kibbler's $12\frac{1}{2}$ -inch reflector at Stamford Hill, and also on May 14 with my own instrument.

Pyriphlegethon (22). Broad and diffuse.

Sitacus (57). Very narrow, dark, curved line. Note on May 14: "Wonderfully distinct this apparition."

Styx (33). Dark and sharply defined on its W. side by the bright region of *Elysium*. Soft and diffuse on E. side. All the region included by the *Hades*, *Boreas*, and *Styx* appeared at times lightly shaded.

Tanais (17). Only a trace seen. The brightness of *Nerigos* (λ) seemed to unite with that of the region W. of *Achillis Fons* and obliterate completely the p. end of *Tanais*.

Thoth (45). Fine narrow line.

Titan (24). Soft, diffuse, and difficult. Not traced beyond the *Orcus*.

Uranus (20). Seen a few times, but rather ill-defined.

A broad streak (21) was seen connecting *Arsenius L.* (n) with the shaded region of *Baltia* (C.).

Another rather faint dusky streak (55) was found running from about $\omega = 290^\circ + 70^\circ$ to the E. side of *Baltia* (C.).

On March 10 and 11, and again on April 17, there appeared to be a "new" canal running from the bend of *Nilosyrtis* ($\omega = 232^\circ$, $\phi = +38^\circ$) towards the *Syrtis Minor*. Subsequently this feature could not be recovered, though on April 19 the *Thoth* was seen with great distinctness.

The "Lakes."—The following were observed:

Arsenius L. (n). Very large and dark spot about 14° N. of *Propontis*.

Coloe Palus (v). Very conspicuous spot at end of *Nilosyrtris*.

Copais Palus (t). Very dark and conspicuous spot.

Hecates L. (p). A conspicuous object.

Hyperboreus L. (e). Very dark and large swelling on band surrounding polar cap.

Ismenius L. (w). Well defined and conspicuous spot. Appeared double on May 12 and 14, when the *Protonilus* was also doubled.

Lunæ L. (d). Fairly dark and conspicuous.

Mareotis L. (f). Quite a dark spot on *Ceraunius* at meeting of this canal with *Nilus*, *Phlegethon*, and *Gigas*.

Mæris L. (s). Dark swelling on *Nepenthes*.

Morpheus L. (r). Not very large, but easily seen. At junction of *Chaos*, *Hyblæus*, and *Marsyas*.

Nectaris Fons (c). Very dark spot seen on May 7, W. of *Protei Regio* (ε), near the mouth of *Nectar*.

Niliacus L. (b). Sharply bounded by *Achillis Pons*, but soft and diffuse to S.

Nodus Gordii (i). A dusky, ill-defined shading about the junction of *Pyriphlegethon* and *Gigas*.

Pambotis L. (q). Seen well at times at junction of *Cyclops* and *Cerberus*.

Phænicis L. (j). Dusky spot seen a few times near extremity of *Pyriphlegethon*.

Phrygius L. (k). Faint dusky spot at the junction of *Gigas* and *Eumenides*. This appears identical with the *Nodus Gordii* of Lowell.

Propontis (m). Much elongated and very dark spot. Appeared almost rectangular at times.

Siloe Fons (a). Rather small, but well defined.

Solis L. (h). Dark and very well seen, despite its proximity to the limb.

Tithonius L. (g). A dark and conspicuous marking.

Trivium Charontis (o). Not quite so large as at some oppositions, but very conspicuous.

A large, ill-defined dusky shading (l) was seen about the junction of *Erebus* and *Titan* ($\omega = 168^\circ$, $\phi = +35^\circ$).

Another dark and large spot (u) was noted at about $\omega = 277^\circ$, $\phi = +66^\circ$. Is this a new feature?

White Regions and Bright Spots.—These furnished the special feature of Mars during the past apparition. As usual, some of the borders of the *Maria* and regions near the limb appeared intensely white. Thus *Elysium* (ς), *Libya* (χ), *Hellas* (ψ), the region *f* *Syrtis Major* and *Pharos Insula* (γ'), *Edom Promontorium* (ς'), *Deucalionis Regio* (α), the S. part of *Chryse* (δ), *Thaumasia* (ι), and the regions of *Phæthontis* (ν), *Electris* (ξ), *Eridania* (ο), and *Noachis* (ε'), foreshortened at the S. limb, all appeared very bright; *Zephyria* (π) and *Æolis* (ρ) also appeared so at the end of May; but the features demanding special notice

were : the E. part of *Elysium* (τ), brilliant spots on *Cydonia* (β) and *Ortygia* (γ), another (η) W. of *Achillis Pons* (ζ) which appeared to extend along the coast of *Acidalium Mare* and *Baltia*, two very brilliant regions whose centres were approximately (κ) at $\omega = 100^\circ$, $\delta = +10^\circ$, and (μ) at $\omega = 128^\circ$, $\delta = +35^\circ$ respectively, and three well-defined bright areas adjoining the dark line bounding the N. polar cap. These latter will be described in the paragraph dealing with the N. polar regions.

As often remarked, the white regions of *Mars* appear much more intense at the limb than near the centre of the disc. A spot comparable with the polar snows in brightness when in the former position (in some instances) fades so as to be distinguishable with difficulty on the central meridian.

During the past apparition the white areas above mentioned were, on the whole, pretty constant in position. Mr. Denning, however (*Monthly Notices* for 1903, June), detected on May 21 a bright band (as of cloud) separating the *Syrtis Major* (H) from the dark regions further S., which by the 23rd had diffused itself over the *Syrtis*, dimming its outlines and making it much paler. On May 22 *Libya* (χ) appeared to me intensely white, but definition about this time was very bad at Croydon and fine details obliterated. On May 24 I noticed that the region of *Zephyria* (π) and *Æolis* (ρ) N. of *Cimmerium Mare* was also whitened, an observation which accords very well with Mr. Denning's notes on the 25th. The *Syrtis Major* was now very faint, but at the time I made no special comment on the fact, attributing it to the bad atmospheric conditions prevailing. Mr. Denning's observations, however, make it clear that about this time a large cloud area drifted over this region of the planet and produced the interesting changes described.

As during the two previous apparitions, it frequently appeared as if a band of cloud or mist (ω) severed the *Nilosyrtis* from the *Syrtis Major*, but I was often unable quite to satisfy myself that the severance was complete.

Achillis Pons (ϵ) was quite conspicuous, though at times it appeared lightly shaded at its eastern end. It was certainly much less bright than the region (θ) between *Baltia* and *Hyperboreus L.*

North Polar Regions.—The region N. of latitude $+70^\circ$ generally appeared considerably lighter in tone than the centre of the disc, and was usually bounded by a dusky streak. The polar cap itself, after being clear in February, seemed to become enveloped in fog (?) at the beginning of March. The following entries referring to this feature were made in my note-book :

March 5. "There appeared to be a certain amount of fog surrounding the snow cap, the latter itself in the moments of better definition appearing quite small. This fog was also suspected on March 1 and 3."

March 7. "There appears to be much fog round the N. Pole, and I don't think the snow itself was glimpsed at all."

March 8. "Large patch at N. Pole, but the snow could be seen at times flashing out with dazzling whiteness."

March 10. "The fog (?) at the N. Pole appears to be diminishing."

March 14. "All trace of fog seems to have left the polar regions. The snow cap was seen now and then in moments of superb definition to be quite definite and bounded by a very narrow dark line, with a somewhat similar but less bright region adjoining it at about $\omega = 220^\circ$."

Of the three bright areas in the N. polar regions, that just mentioned (ν) was the first to be observed; subsequent observations seemed to place its centre at a little over 200° of longitude. It was frequently a conspicuous object, and towards the end of April was found to be sharply bounded at its p. side by the canal *Magnes*.

On March 31 I noticed an intensely bright streak (θ) severing *Baltia* from the dark shading round the polar snow. On April 29 and May 1 the p. end of this region was comparable with the cap itself in brightness, but f this bright nucleus there seemed to be a dusky projection from *Baltia* extending towards *Hyperboreus L.* This projection, however, was not subsequently observed.

A third very brilliant region (δ') was detected on May 14 adjoining the polar snow cap. It was again seen on May 15 and 19, and the longitude found to be about 295° .

After the disappearance of the fog or mist in the early part of March the snow cap was seen to be bounded by an intensely dark line. This line was quite narrow in most longitudes, but at the end of March it was found greatly swollen at about $\omega = 60^\circ$. This swelling, which on April 24 seemed to indent the snow cap, is doubtless identical with *Hyperboreus L.* of Schiaparelli. It was intensely dark against the snow, but appeared to shade off gradually in an sf direction.

At the time of opposition the season of the planet's N. hemisphere was a little past midsummer, and the polar cap was quite small. It seemed to diminish but very slowly subsequently, the minimum diameter (observed in May) being estimated at about 10° or 12° . The snow at times shone with a slightly bluish tinge.

To sum up the results of my observations, a careful and systematic scrutiny of the planet during the past four apparitions has revealed to me the following facts:

(1) Changes, partly due to seasonal influences and the appearance of clouds or mists, and partly real, unquestionably occur from time to time in the details of the surface configuration.

(2) The main results of Professor Schiaparelli's work are imperishable and beyond question. During recent years some

observers have given to the so-called "canals" a hardness and an artificiality which they do not possess, with the result that discredit has been brought upon the whole canal system. No doubt the time has come when a distinction must be made between what is real on *Mars* and what is subjective or illusory, but of the substantial accuracy and truthfulness (as a basis on which to work) of the planet's configuration as charted by the great Italian in 1877 and subsequent years, there is, in my mind, no doubt.

(3) Contrast, as has been so ably pointed out by M. E. M. Antoniadi, is doubtless accountable for very many of the extraordinary appearances observed on the planet. Not a few of the canals are now seen to be the intensified edges of faint tones in accordance with the late Mr. Green's suggestion, while M. Antoniadi's explanation of the phenomena of gemination as due to the same effect of contrast appears both simple and satisfactory.

Observations of White Spots on Saturn in 1903.
By A. Stanley Williams.

The visibility of a bright spot on *Saturn* was announced by Professor E. E. Barnard on June 24 of the present year. Unfortunately I had just left England for Ireland, so that, although Professor Kreutz kindly sent me a postcard announcing the discovery, it was only on my return home towards the end of July that I heard of the existence of the spot, and was able to make any observations of the planet. At that time the probable position of the spot detected by Barnard was quite unknown, so that I confined my attention simply to observing the transits of any spots that might happen to be visible, purposely avoiding any attempt at comparing the observations, or to identify them with the spot referred to, in order that the observations might not be biassed thereby.

The observations recorded below all relate to white spots * situated in a bright zone lying to the north of a broad dark band on the north side of the bright equatorial zone. The former bright zone is hereafter termed the N. temperate zone. The broad dark band between it and the equatorial zone has been called the N. equatorial belt. It is actually coarsely double, consisting of two dark bands separated by an ill-defined lighter interval, not so bright or definite as either the equatorial zone or the N. temperate zone. The telescope used was a 6½-inch reflector, a power of 225 being always employed. At first great

* I have called the spots *white* spots for distinction, but they have usually appeared to me to be distinctly yellowish.